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ELECTROMAGNETIC RADIATION SYSTEM (EMRS) FOR SUSCEPTIBILITY TEST--ETC(U)

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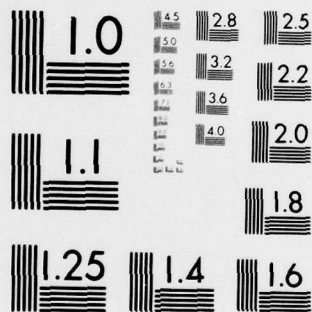
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RESEARCH AND DEVELOPMENT TECHNICAL REPORT
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ELECTROMAGNETIC RADIATION SYSTEM (EMRS)
FOR SUSCEPTIBILITY TESTING

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Quarterly Report for Period: 1 October 1978 - 31 December 1978

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The function of the Electromagnetic Radiation System (EMRS) is to generate electromagnetic energy to produce a constant field strength that can be automatically scanned as a function of frequency. The design objective is to cover the frequency range of 30 hertz to 40 gigahertz with field strength intensities up to 200 volts per meter. This report describes system equipment status and results of performance tests in all demonstration frequency ranges (30-60 MHz, 1.0-2.1 GHz, 2.1-4.0 GHz and 12.4-18.0 GHz).		

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I. INTRODUCTION

This report describes the activities and developments concerning Phase II of the Electromagnetic Radiation System (EMRS) Program during the period of 1 October 1978 through 31 December 1978. The purpose of Phase II of the EMRS program is to develop the hardware to demonstrate the feasibility of the theoretical design considered in Phase I.

II. STATUS OF EMRS EQUIPMENT

All major equipment comprising the EMRS demonstration system has been received, with the exception of the following:

1. Hewlett-Packard 8495H calibrated attenuator, required to perform measurements in the 12.4-18 GHz range, had to be returned to the manufacturer for repair. Delivery is expected during January 1979.
2. Tunable bandpass filters for the 1 GHz - 2.1 GHz, 2.1 GHz - 4 GHz and 12.4 GHz - 18 GHz frequency ranges have not yet been received. The most recent estimates of delivery are shown below:
 - 1 GHz - 2.1 GHz Filter: 5 February 1979
 - 2.1 GHz - 4 GHz Filter: 5 March 1979
 - 12.4 GHz - 18 GHz Filter: 31 March 1979

III. PROGRESS DURING REPORT PERIOD

During this period, the Logimetrics A200U amplifier, for the 12.4 GHz to 18 GHz range, was repaired by the manufacturer and returned to AEL. It was installed in the system, checked out and found to operate properly.

Tests were performed, in accordance with the EMRS Test Plan dated July 1978, on the 1 GHz - 2.1 GHz, 2.1 GHz - 4 GHz and 12.4 GHz - 18 GHz portions of the system. (The range of 30 MHz to 60 MHz had been tested during the previous quarter.) Results are summarized in Tables 1 through 4, for all four bands.

Table 1 shows that the 30 MHz to 60 MHz EMRS demonstration system met all requirements specified in the test plan for the following tests: Frequency Accuracy, External AM, External FM, High-Level Radiated Output and Level Variation and Non-Radiated Output and Level Variation. It did not meet all requirements for External Pulse Modulation and Low-Level Radiated Output and Level Variation. Tests for Scan Rate and Signal Purity were not performed because they require installation of the 30 MHz to 60 MHz tunable filter.

The 30 MHz to 60 MHz tunable filter was delivered to AEL on 27 December 1978. Its performance is being checked in preparation for its installation in the system.

Table 2 shows that the 1 GHz to 2.1 GHz EMRS demonstration system met all requirements specified in the test plan for the following tests: Frequency Accuracy, External AM, External FM, High-Level Radiated Output and Level Variation and Non-Radiated Output and Level Variation. It did not meet all requirements for External Pulse Modulation and Low-Level Radiated Output and Level Variation. Tests for Scan Rate and Signal Purity were not performed because they require delivery and installation of the 1 GHz to 2.1 GHz tunable filter.

Table 3 shows that the 2.1 GHz to 4.0 GHz EMRS demonstration system met all requirements specified in the test plan for the following tests: Frequency Accuracy, External FM, High-Level Radiated Output and Level Variation and Non-Radiated Output and Level Variation. It did not meet all requirements for External AM, External Pulse Modulation and Low-Level Radiated Output and Level Variation. Tests for Scan Rate and Signal Purity were not performed because they require delivery and installation of the 2.1 GHz to 4.0 GHz tunable filter.

Table 4 shows that the 12.4 GHz to 18 GHz EMRS demonstration system met all requirements specified in the test plan for the following tests: Frequency Accuracy, External AM, External FM, High-Level Radiated Output and Level Variation and Non-Radiated Output and Level Variation. It did not meet all requirements for External Pulse Modulation. The test for Low-Level Radiated Output and Level Variation was not performed because it requires an attenuator now being repaired by the manufacturer. Tests for Scan Rate and Signal Purity were not performed because they require delivery and installation of the 12.4 GHz to 18 GHz tunable filter.

Other work in progress includes a redesign of the external levelling circuit, to perform levelling functions for tuning the filters as well as to maintain the output of the system at a constant level. Work is also in progress to improve the performance of the external pulse modulation circuit.

It was found that the use of an external preamplifier, to increase the level of the sampled radiated signal, is a feasible approach for increasing the dynamic range of the system to lower minimum output. Further research will be done to determine selection of commercial preamplifiers for this purpose.

IV. FUTURE PLANS

During the next reporting period, the following activities are anticipated:

1. Receipt of the repaired attenuator, and performance of the Low-Level Radiated Output and Level Variation test in the 12.4 GHz to 18 GHz range.
2. Completion of redesign work on the external levelling circuit and tests of its performance.
3. Receipt of the 1 GHz to 2.1 GHz filter and performance of Scan Rate and Signal Purity tests in this range.
4. Receipt of the 2.1 GHz to 4 GHz filter and performance of Scan Rate and Signal Purity tests in this range.
5. Installation of the 30 MHz to 60 MHz filter and performance of Scan Rate and Signal Purity tests in this range.

TABLE 1 - SUMMARY OF EMRS TEST RESULTS, 30-60 MHZ FREQUENCY BAND

<u>TEST PLAN PARA.</u>	<u>TEST DESCRIPTION</u>	<u>REQUIREMENT</u>	<u>RESULTS</u>
5.1.2	Frequency Accuracy	Manual: + 10 MHz Auto: ± 5 MHz	Meets requirements Meets requirements
5.1.3	Scan Rate Limits (Automatic Sweep)	Less than or equal to 5 seconds/octave to more than 100 seconds/octave	Awaiting final instal- lation of filter
5.1.4	External Modulation:		
	AM	0-100%, DC-150 kHz	Meets requirements
	FM	± 20 MHz, DC-100 Hz ± 5 MHz, 100 Hz - 1 MHz ± 2 MHz, 1-2 MHz	Meets requirements
	Pulse, Rise Time	50 nanoseconds	20 nS minimum with internal levelling (See Note 1)
	Pulse, Fall Time	50 nanoseconds	Over 20 nS with inter- nal levelling (Note 1)
	Pulse Width	50 nS - 50 mS	100 nS - 20 mS with internal levelling (Notes 1 and 2)
5.1.5	Radiated Output:		
	High	200 V/M ± 3 dB	Meets requirements
	Low	1 mV/M ± 3 dB	(Note 3)
5.1.6	Non-Radiated Output	10 watts ± 3 dB	Meets requirements
5.1.7	Signal Purity	Harmonics and spuri- ous emission at least 100 dB below fundamental	Awaiting final instal- lation of filter

- NOTES:
1. With external levelling, too much overshoot and ringing were found. Levelling circuit is being redesigned.
 2. System functions with longer pulses but output level varies if duty cycle exceeds 50%. Meets requirements with lower duty cycle.
 3. System dynamic range is 40 dB, for 2 V/M minimum output. Adding external Hewlett-Packard 8447D amplifier to levelling loop adds 26 dB to dynamic range, for a minimum of 100 mV/M.

TABLE 2 - SUMMARY OF EMRS TEST RESULTS, 1-2.1 GHZ FREQUENCY BAND

<u>TEST PLAN PARA.</u>	<u>TEST DESCRIPTION</u>	<u>REQUIREMENT</u>	<u>RESULTS</u>
5.2.2	Frequency Accuracy	Manual: + 10 MHz Auto: ± 5 MHz	Meets requirements Meets requirements
5.2.3	Scan Rate Limits (Automatic Sweep)	Less than or equal to 5 seconds/octave to more than 100 seconds/octave	Awaiting delivery of filter
5.2.4	External Modulation:		
	AM	0-100%, DC-150 kHz	Meets requirements
	FM	+ 75 MHz, DC-100 Hz ± 5 MHz, 100 Hz - 1 MHz ± 2 MHz, 1-2 MHz	Meets requirements
	Pulse, Rise Time	50 nanoseconds	20 nS minimum with internal levelling (See Note 1)
	Pulse, Fall Time	50 nanoseconds	Over 20 nS with inter- nal levelling (Note 1)
	Pulse Width	50 nS - 50 mS	100 nS - 20 mS with internal levelling (Notes 1 and 2)
5.2.5	Radiated Output:		
	High	200 V/M ± 3 dB	Meets requirements
	Low	1 mV/M ± 3 dB	(Note 3)
5.2.6	Non-Radiated Output	+30 dBm ± 3 dB	Meets requirements
5.2.7	Signal Purity	Harmonics and spur- ious emission at least 100 dB below fundamental	Awaiting delivery of filter

- NOTES: 1. With external levelling, too much overshoot and ringing were found. Levelling circuit is being redesigned.
2. System functions with longer pulses, but output level varies if duty cycle exceeds 50%. Meets requirements with lower duty cycle.
3. System dynamic range is 44 dB, for 1.3 V/M minimum output.

TABLE 3 - SUMMARY OF EMRS TEST RESULTS, 2.1-4.0 GHZ FREQUENCY BAND

<u>TEST PLAN PARA.</u>	<u>TEST DESCRIPTION</u>	<u>REQUIREMENT</u>	<u>RESULTS</u>
5.3.2	Frequency Accuracy	Manual: + 20 MHz Auto: ± 30 MHz	Meets requirements Meets requirements
5.3.3	Scan Rate Limits (Automatic Sweep)	Less than or equal to 5 seconds/octave to more than 100 seconds/octave	Awaiting delivery of filter
5.3.4	External Modulation:		
	AM	0-100%, DC-150 kHz	See Note 1
	FM	+ 75 MHz, DC-100 Hz ± 5 MHz, 100 Hz - 1 MHz ± 2 MHz, 1-2 MHz	Meets requirements
	Pulse, Rise Time	50 nanoseconds	20 nS minimum with internal levelling (Note 2)
	Pulse, Fall Time	50 nanoseconds	Over 20 nS with Inter- nal levelling (Note 2)
	Pulse Width	50 nS - 50 mS	100 nS - 20 mS with internal levelling (Notes 2 and 3)
5.3.5	Radiated Output:		
	High	200 V/M ± 3 dB	Meets requirements
	Low	1 mV/M ± 3 dB	See Note 4
5.3.6	Non-Radiated Output	+30 dBm ± 3 dB	Meets requirements
5.3.7	Signal Purity	Harmonics and spur- ious emission at least 100 dB below fundamental	Awaiting delivery of filter

- NOTES: 1. Modulation applied directly to generator limited to 60% maximum. Modulation applied to external AM circuitry will go to 100% but distortion is high (many extraneous signals).
2. With external levelling, too much overshoot and ringing were found. Levelling circuit is being redesigned.
3. System functions with longer pulses, but output level varies if duty cycle exceeds 50%. Meets requirements with lower duty cycle.
4. System dynamic range is 40 dB, for 2 V/M minimum output.

TABLE 4 - SUMMARY OF EMRS TEST RESULTS, 12.4 GHZ - 18 GHZ FREQUENCY RANGE

<u>TEST PLAN PARA.</u>	<u>TEST DESCRIPTION</u>	<u>REQUIREMENT</u>	<u>RESULTS</u>
5.4.2	Frequency Accuracy	Manual: + 50 MHz Auto: + <u>70</u> MHz	Meets requirements Meets requirements
5.4.3	Scan Rate Limits (Automatic Sweep)	Less than or equal to 5 seconds/octave to more than 100 seconds/octave	Awaiting delivery of filter
5.4.4	External Modulation:		
	AM	0-100%, DC-150 kHz	Meets requirements
	FM	+ 75 MHz, DC-200 Hz <u>±</u> 5 MHz, DC-200 kHz	Meets requirements
	Pulse, Rise Time	50 nanoseconds	30 nS with both external and internal levelling
	Pulse, Fall Time	50 nanoseconds	70 nS with external levelling, 4 uS with internal levelling
	Pulse Width	50 nS - 50 mS	100 nS - 10 mS with internal and external levelling
5.4.5	Radiated Output:		
	High	200 V/M <u>±</u> 3 dB	Meets requirements
	Low	1 mV/M <u>±</u> 3 dB	Awaiting repair of required attenuator
5.4.6	Non-Radiated Output	+30 dBm <u>±</u> 3 dB	Meets requirements
5.4.7	Signal Purity	Harmonics and spur- ious emission at least 100 dB below fundamental	Awaiting delivery of filter

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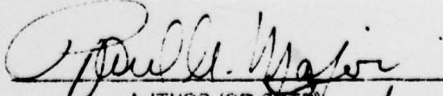
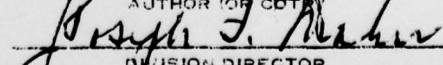
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